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Donohue

Landfill Impact Evaluation

USAR Center Complex and Training Area
Milwaukee, Wisconsin

U.S. Army Corps of Engineers
Omaha District

April 1985

Engineers & Architects

Donohue

April 8, 1985

Fort McCoy
AFZR-FDP
Sparta, WI 54656-5000

Attn: Mr. John Ipsen, Chief
Engineering and Planning Services

Re: Transmittal of Report Titled "Landfill Impact Evaluation"
U.S. Army Reserve Center Complex and Training Area
Milwaukee, Wisconsin
Donohue Project No. 13590.008

Dear Mr. Ipsen:

Enclosed is our final report discussing our soils, groundwater, and surface water evaluation at the USAR Center Complex and Training Area on West Silver Spring Drive in Milwaukee, Wisconsin. We found no significant impact of the landfill on the soil and groundwater immediately surrounding the landfill or on the surface water of Lincoln Creek. We recommend that the monitoring wells used in this study be abandoned in accordance with DNR guidelines to eliminate the possibility of well destruction or groundwater contamination by vandals.

If you have any questions concerning the results discussed in this report, please contact this office.

Very truly yours,

DONOHUE & ASSOCIATES, INC.

Richard E. Fedler, P.E.
Vice President

Michael L. Crosser
Project Manager

MC/dlj

cc: Major Donald Rinzel

R/COE2/AB1

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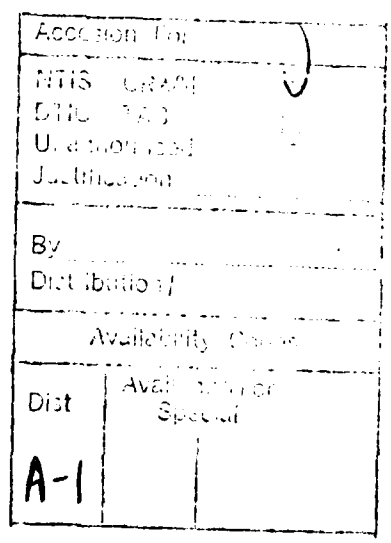
LANDFILL IMPACT EVALUATION
UNITED STATES ARMY RESERVE CENTER COMPLEX
AND TRAINING AREA
84TH DIVISION
MILWAUKEE, WISCONSIN



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REP/COE2/AB3

INTRODUCTION

The Department of the Army proposes expansion of the building complex and development of the outdoor training area at the Milwaukee USAR Center Complex and Training Area located on West Silver Spring Drive in Milwaukee, Wisconsin. In February, 1984, the Department of the Army issued an Environmental Assessment and a Finding of No Significant Impact Report addressing the project (Department of the Army, 1984).

The land use history section of the Environmental Assessment indicates that the Milwaukee Sanitation Department disposed of approximately 500,000 cubic yards of solid waste on the present complex site between 1957 and 1966. According to correspondence from the City of Milwaukee, the material disposed at the site was furniture, appliances, street sweepings, leaves, tin cans, bottles, ashes, cinder, and sewer pipe. There were no newspapers, garbage, or other types of putrescible materials disposed. No industrial or hazardous waste was accepted. During the landfill operation, earth berms were constructed to minimize the flow of potential pollutants to Lincoln Creek which flows between the two landfill cells. In 1983, the Wisconsin DNR collected a sample of seepage from the landfill berm to Lincoln Creek. The DNR had the sample analyzed at the Wisconsin State Laboratory of Hygiene and concluded that the seepage discharge did not contain pollutant concentrations that would be detrimental to public health, wildlife, fish and aquatic life. (Department of the Army, 1984).

In 1983, samples of Lincoln Creek upstream and downstream of the landfill cells were collected and analyzed. The analysis showed no indication of pollution from the landfills. (Department of the Army, 1984).

In September of 1984, the U.S. Army Corps of Engineers, Omaha District retained Donohue to conduct evaluations to determine the impact of the landfill on nearby soil and groundwater. Donohue installed monitoring well nests to determine the water quality of the groundwater near the surface of the groundwater table and at depth. During the soil boring operations, soil samples were analyzed in the field using an HNu photoionization detector to determine the presence of hydrocarbons. The air in the bore hole was also analyzed to determine the presence of methane or other hydrocarbons.

In this report we present a description of the regional geology and hydrogeology, a description of our field investigation procedures, the results of our investigation and our conclusions and recommendations.

REGIONAL GEOLOGY AND HYDROGEOLOGY

The Army Reserve site is located over glacial drift material. The most important glacial unit occurring at the site is interpreted to be the Oak Creek formation which consists of fine grained till, lacustrine clay, silt, and sand and glaciofluvial sand and gravel. Beneath the Oak Creek till is the New Berlin till which is substantially coarser grained, consisting of silty and clayey sands and gravels. Below the glacial material is bedrock which consists of Silurian Age Niagara dolomite which forms the first aquifer in the area.

FIELD INVESTIGATION PROCEDURES

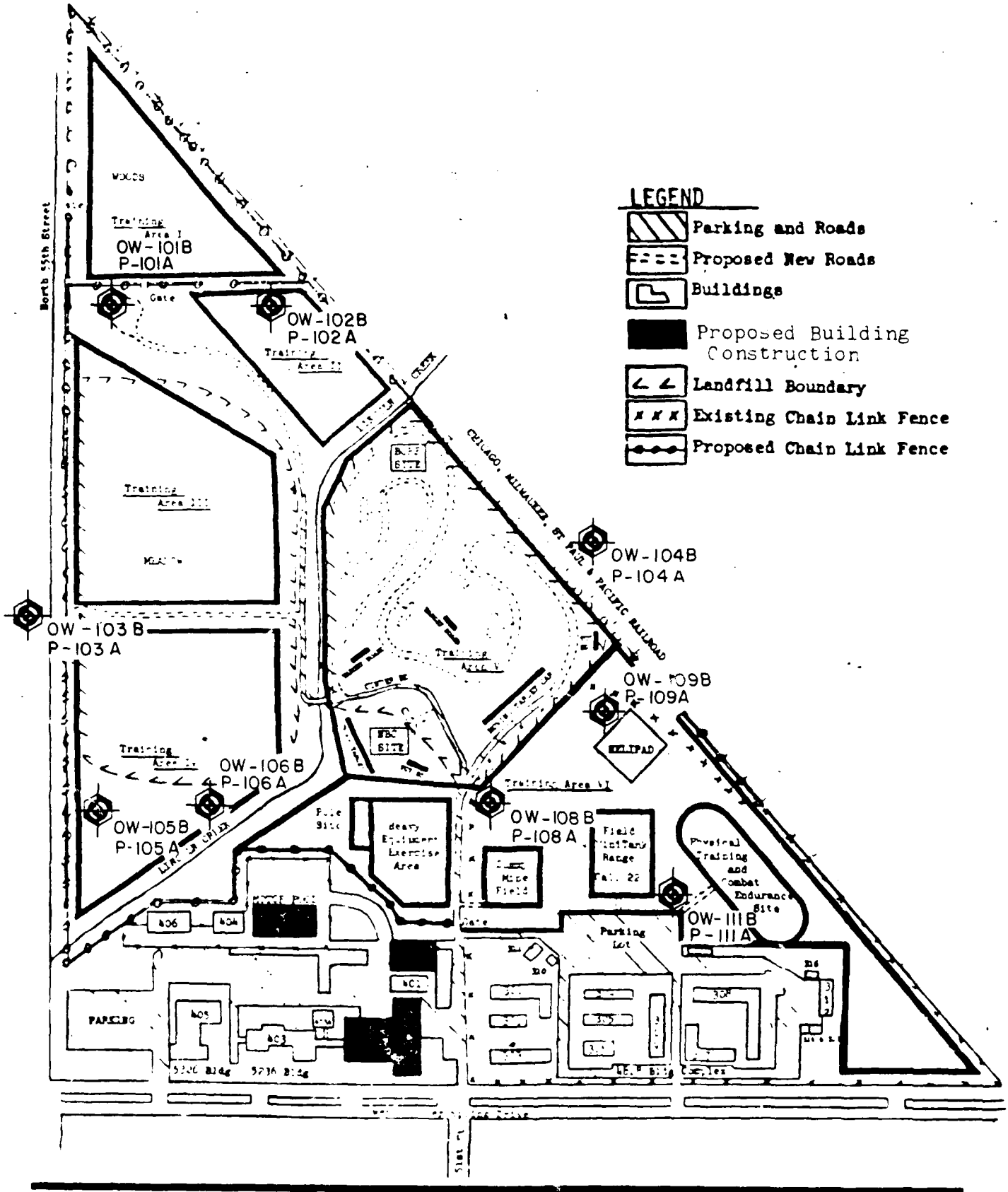
Well Locations

Nine nested wells were placed surrounding the closed landfill to monitor the groundwater around the site. The general locations are shown on Figure 1. The location coordinates and elevation are given in Table 1. Wells 101 and 102 were located in the suspected upgradient groundwater flow direction. All other wells were placed to surround the site and detect downgradient contamination if present. Nested wells were installed to serve two purposes. First, they allowed the determination of the water table and vertical hydraulic gradients in the site; secondly, they allowed groundwater monitoring at the water table surface and deeper in the groundwater flow system. The depth of the shallow observation wells was 20 feet while the deeper wells were generally 40-45 feet deep.

Well Installation Procedures and Borehole Monitoring

Wells were constructed of 2 inch, Schedule 40 PVC. Observation wells were fitted with a 10 foot section of factory slotted, No. 10 slot well screen, while piezometers were constructed with 5 foot slotted sections. Wells were installed using a 6 inch O.D. hollow stem auger or flight augers and roller bitting into bedrock. Standard split-spoon samples were taken at 5 foot intervals. Boring logs and well installation diagrams are attached as Appendix A.

Well screens were surrounded by a silica sand pack which extends to 7 feet below ground surface in observation wells and approximately 1 foot above the screen in piezometers. In shallow observation wells a minimum 2 foot thick bentonite seal followed by a concrete cap was placed at the top of the installation. In the piezometers, a minimum 5 foot bentonite seal was placed above the screen followed by either bentonite cement grout or the hole was allowed to cave above the seal and backfilled with sand. At the surface, a second 2 foot thick bentonite seal was placed with a concrete cap above.



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GROUNDWATER MONITORING WELLS

13590 008
MARCH 1985

GROUNDWATER INVESTIGATION
MILWAUKEE USAR CENTER COMPLEX AND TRAINING AREA
MILWAUKEE, WISCONSIN

FIGURE 1

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TABLE 1
MONITORING WELL LOCATIONS AND ELEVATIONS
WISCONSIN STATE PLANE COORDINATE SYSTEM,
SOUTH ZONE

Well No.	Y Value	X Value	Elevation (NVD 1929)
OW101	417,120.9	2,539,200.1	686.95 TOPP 686.89 TPVC
P101	417,122.9	2,539,195.3	686.88 TOPP 686.86 TPVC
OW102	417,114.4	2,539,732.2	686.20 TOPP 686.04 TPVC
P102	417,113.1	2,539,738.2	686.12 TOPP 685.99 TPVC
OW103	415,878.8	2,538,943.5	681.72 TOPP 681.18 TPVC
P103	415,879.8	2,538,946.4	682.11 TOPP 681.98 TPVC
OW104	416,344.7	2,540,766.0	692.25 TOPP 691.98 TPVC
P104	416,341.5	2,540,761.6	692.39 TOPP 692.11 TPVC
OW105	415,395.9	2,539,101.0	677.47 TOPP 677.28 TPVC
P105	415,392.3	2,539,100.6	677.67 TOPP 677.43 TPVC
OW106	415,405.4	2,539,464.0	677.21 TOPP 677.07 TPVC
P106	415,408.5	2,539,462.7	677.17 TOPP 677.02 TPVC
OW108	415,740.9	2,540,544.3	696.90 TOPP 696.58 TPVC

TABLE 1 Continued

Well No.	Y Value	X Value	Elevation (NVD 1929)
P108	415,733.8	2,540,540.4	696.62 TOPP 696.48 TPVC
OW109	415,810.7	2,540,797.2	695.15 TOPP 694.99 TPVC
P109	415,814.4	2,540,793.9	695.01 TOPP 694.88 TPVC
OW111	415,375.6	2,541,016.9	691.07 TOPP 690.93 TPVC
P111	415,372.3	2,541,016.7	691.10 TOPP 690.97 TPVC

TOPP = Top of Protector Pipe
TPVC = Top of PVC
NVD = National Vertical Datum

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During drilling, a photoionization analyzer (HNu) was used to determine presence of organic vapors. Auger cuttings and split spoon samples were placed in zip-lock bags and allowed to equilibrate with the air for 5-10 minutes, then the HNu probe was inserted through a small opening in the bag and the reading recorded. Water samples collected during drilling from the well were placed in a glass jar and capped with a screw-on lid. The HNu probe was inserted through a small hole in the lid and the measurement recorded. Vapors in the borehole were also monitored for oxygen concentration and the lower explosive limit using a combustible/oxygen monitor.

Geology

Bedrock across most of the site was usually deeper than approximately 45 feet, however, at B109 and B108 bedrock was encountered at a depth of 27 feet and 32 feet respectively and at B111 auger refusal occurred at 38.5 feet. These depths indicate that a bedrock high occurs in the southeast portion of the site and the bedrock surface becomes deeper to the west.

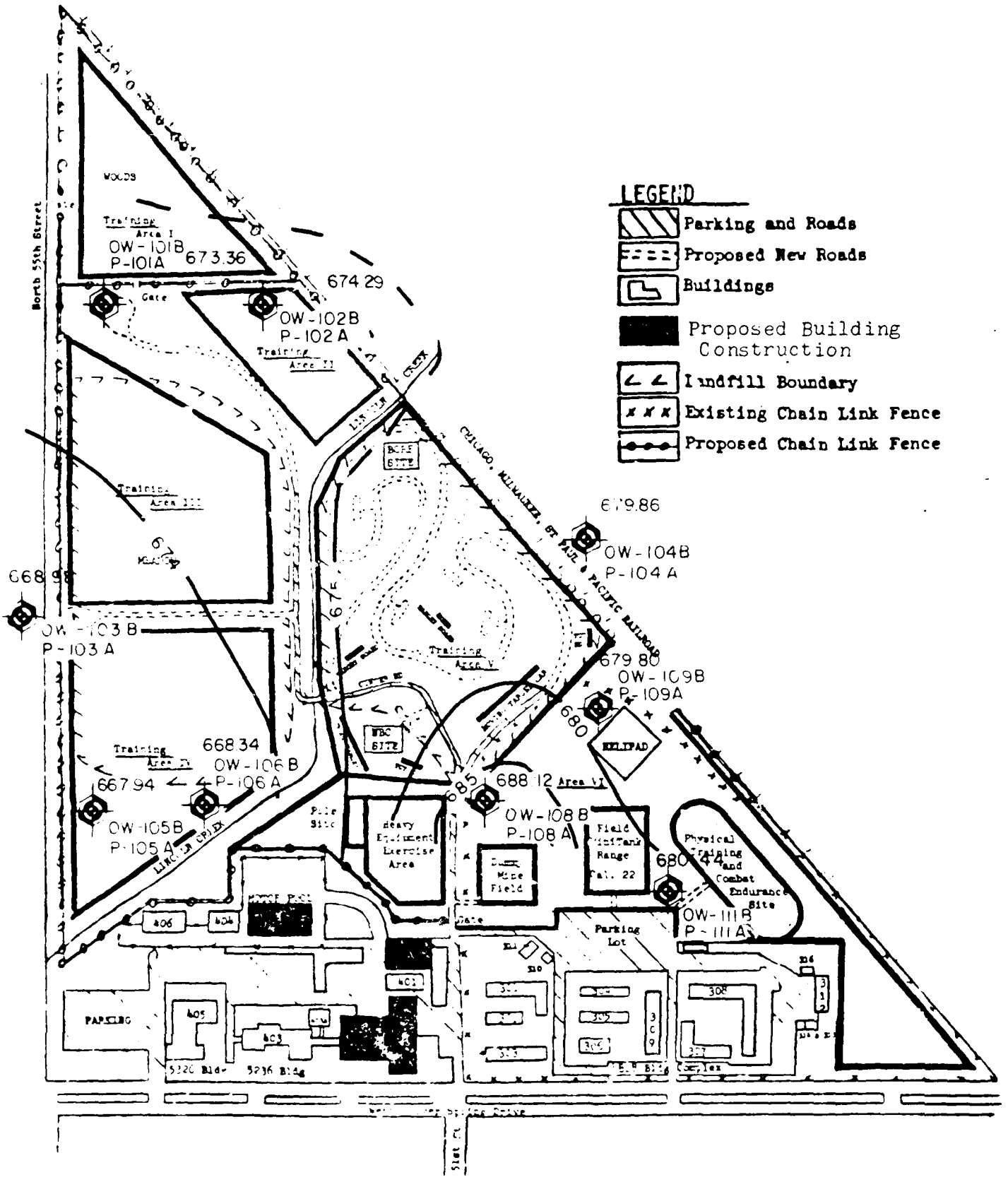
Groundwater Flow

Figure 2 shows a water table contour map that was constructed from water elevations taken on February 13, 1985. This groundwater contour map indicates that there is a water table high located in the south central portion of the site. Flow from this area moves laterally and downward towards the east, west, and north. It is expected that away from the mound the predominant local direction of groundwater flow is towards the west. Wells along the eastern portion of the site (104, 108, and 111) show downward vertical gradients indicating groundwater recharge occurring in these areas. Wells along the western portion of the site including 101, 102, 103, 105, and 106 show either very little vertical gradients or upward gradients. Since the vertical gradients become upward along the western portion of the site, groundwater recharge which occurred on the eastern portion of the site would not be expected to move deep into the groundwater flow system.

WELL DEVELOPMENT AND SAMPLING

Development

The groundwater monitoring wells and piezometers were developed after initial well installation but no sooner than 48 hours after grouting was completed. Field records of the well development procedures can be found in Appendix B.



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GROUNDWATER CONTOUR MAP

N

GROUNDWATER INVESTIGATION
MILWAUKEE USAR CENTER COMPLEX AND TRAINING AREA
MILWAUKEE, WISCONSIN

FIGURE 2

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Wells were developed using a gas driven centrifugal pump and a submersible Johnson Keck pump. All equipment, tubing and hose were rinsed with deionized water between use at each well. Where the well boring was made without the use of drilling fluid, five times the standing water volume in the well was removed. The standing water volume included the water volume within the well screen and casing plus the saturated annulus. Wells where the boring was made or enlarged with the use of drilling fluid (water), five time the amount of standing water volume in the well was removed in addition to the estimated water lost during drilling.

Where water still remained turbid after development, additional volumes of water were removed.

Chemical and physical characteristics of the water removed at each well were measured before, during, and after completion of well development. These measurements included turbidity, color, odor, conductivity, pH, temperature, and the physical description of the sediment. These measurements are presented on the well development field logs in Appendix B. Following development, the wells were allowed to stand without activity for a minimum of two weeks before purging and sampling.

Purging

To remove stagnant water from the monitoring wells and to draw representative groundwater into the well for sample collection, all wells on-site were purged prior to sample collection.

To determine the volume of water to be purged from each well, the depth to the static water level and depth to the bottom of the well were measured from the top of the two-inch diameter PVC well pipe using a fiberglass tape. Between measurements at each well, the tape was rinsed several times with deionized water. Based on the depth to water, the total depth of the well and the diameter of the well, the volume of water standing in the well (well volume) was calculated using the following equation:

$$\text{Well Volume} = 3.14 \left(\frac{d}{4}\right)^2 \times H \times 7.48$$

Where:

d = diameter of well = 0.167 feet
H = Height of water = depth to bottom - depth to water level (feet)

For wells with rapid recovery rates, a total of three well volumes of water was removed. Where water recovery rates were not rapid, the wells were bailed dry and then allowed to recover prior to sample withdrawal.

Table 2 shows the well water elevation measurements and volumes of water removed from each well during the sampling events.

All wells on site were purged using a PVC single check valve bailer attached to a rope. In practice, the single check valve bailer is lowered into the well annulus, water enters the chamber through the bottom, and the weight of the water column once in the bailer closes the check valve upon bailer retrieval. Upon bailer retrieval, the ball immediately seats itself without water loss through the check valve.

All water purged from the monitoring wells was discarded. Two bailers were used for the bailing process, dedicating one bailer for use on all observation monitoring wells with depths up to 25 feet and one bailer for use on all piezometers with depths up to 45 feet. At each monitoring well, the bailers and rope were rinsed with deionized water before bailing the next well. The approximate time between purging and sample collection was from 1 to 1.5 days.

Sample Collection

Samples were collected from all 18 monitoring wells and piezometers. On the first day of sampling, samples from sites 101, 102, 103, and 104 were collected. On the second day of sampling, samples were collected at sites 105, 106, 111, 109, and 108. Before sampling at each well, depth to static water level was measured and recorded.

As established during initial bailing of the wells, samples from each well were collected using dedicated PVC single check valve bailers. At each well the first water sample collected with the bailer was discarded and the second bailer volume collected was used to rinse out the plastic Nalgene sample bottle. The following bailer volumes of sample were transferred from the bailer to the sample holding container, filling the container slowly to avoid unnecessary aeration of the sample. Between each well sampling, the bailer and rope were rinsed several times with deionized water before collecting the next well sample.

Field Measurements and Filtration

Immediately upon collection, sample temperature, color, odor, and visual turbidity were recorded. The sample was transferred from the sample holding container to a Millipore pressure filtration

TABLE 2

WATER ELEVATION AND WELL VOLUMES PURGED

Well No.	Depth to Bottom of Well from Top of PVC Pipe (feet)	Well Elevation Top of PVC Pipe (Feet)	Depth to Water Level from Top of PVC Pipe (feet)	Well Volume Purged (gallons)	Groundwater Elevation (Feet)
P101A					
1/3-4/85	48.92	686.76	12.19	18	674.57
2/13-14/85	48.92	686.76	12.63	17.5	674.13
OW101B					
1/3-4/85	21.46	686.89	13.00	4	673.89
2/13-14/85	21.46	686.89	13.53	4	673.36
P102A					
1/3-4/85	47.43	685.99	11.18	7*	674.81
2/13-14/85	47.43	685.99	11.76	7*	674.23
OW102B					
1/3-4/85	21.46	686.04	11.28	5	674.76
2/13-14/85	21.46	686.04	11.75	5	674.29
P103A					
1/3-4/85	46.88	681.98	10.43	7*	671.55
2/13-14/85	46.88	681.98	11.13	5*	670.85
OW103B					
1/3-4/85	22.47	681.18	11.35	2*	669.83
2/13-14/85	22.47	681.18	12.20	3	668.98
P104A					
1/3-4/85	38.32	692.11	17.18	3*	674.93
2/13-14/85	38.32	692.11	17.75	7*	674.36
OW104B					
1/3-4/85	23.23	691.98	10.51	3*	681.47
2/13-14/85	23.23	691.98	12.12	3*	679.86
P105A					
1/3-4/85	45.86	677.43	6.70	19	670.73
2/13-14/85	45.86	677.43	7.43	18	670.00
OW105B					
1/3-4/85	23.02	677.28	8.30	7	668.98
2/13-14/85	23.02	677.28	9.34	7	667.94
P106A					
1/3-4/85	46.45	677.02	8.90	8*	668.12
2/13-14/85	46.45	677.02	10.20	7*	666.82
OW106B					
1/3-4/85	20.93	677.07	6.90	3*	670.17
2/13-14/85	20.93	677.07	8.73	4*	668.34

TABLE 2
(Continued)

Well No.	Depth to Bottom of Well from Top of PVC Pipe (feet)	Well Elevation Top of PVC Pipe (Feet)	Depth to Water Level from Top of PVC Pipe (feet)	Well Volume Purged (gallons)	Groundwater Elevation (Feet)
P111A					
1/3-4/85	40.70	690.97	11.68	7*	679.29
2/13-14/85	40.70	690.97	13.25	5*	677.72
OW111B					
1/3-4/85	22.50	690.93	7.22	7	683.71
2/13-14/85	22.50	690.93	10.49	3*	680.44
P109A					
1/3-4/85	39.14	694.88	13.60	5*	681.28
2/13-14/85	39.14	694.88	15.40	5*	679.48
OW109B					
1/3-4/85	22.46	694.99	13.00	5	681.99
2/13-14/85	22.46	694.99	15.19	8	679.80
P108A					
1/3-4/85	44.62	696.48	14.20	15	682.28
2/13-14/85	44.62	696.48	16.08	14	680.40
OW108B					
1/3-4/85	23.45	696.58	7.26	3*	689.32
2/13-14/85	23.45	696.58	8.46	6*	688.12

* Bailed Dry

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vessel where it was filtered through a 0.45 micron filter using pressurized nitrogen. Immediately after filtration, the field pH and conductivity were measured. Field pH was measured using an Orion Research Model 201 digital temperature compensating pH meter. Prior to any sample measurements, the pH meter was standardized using pH buffer solutions of 4.01, 7.41, and 10.00. During sample measurement, standards were checked periodically. The pH probe was rinsed with deionized water after each standard and sample measurement. All pH measurements were recorded on a field record log.

A Lab-Line conductivity meter that is temperature compensating was used to measure field conductivity on all samples collected. Prior to measuring samples, the meter was standardized against a known standard. The measurement cells were rinsed several times with deionized water after checking standards and after each sample measurement. All field conductivity measurements were recorded on a field record log.

Preservation

Samples collected from the monitoring wells were contained in plastic bottles that had been previously washed and rinsed with deionized water. After filtration, sample collected from each monitoring well was divided into four separate bottles each with the appropriate volume of chemical preservatives added for required sample analytes.

Labels were secured to each sample bottle noting sample location and identification, date of sample collection, analysis required, and initials of personnel collecting the samples. One liter of sample was left unpreserved for total dissolved solids, nitrate nitrogen, chloride, fluoride, and sulfate. A 500 ml bottle of sample was preserved with zinc acetate and sodium hydroxide for sulfide analysis, one 500 ml bottle of sample was preserved with concentrated nitric acid for total hardness and metals analysis, and one 250 ml bottle of sample was preserved with sulfuric acid for low level chemical oxygen demand.

Field Quality Control

Prior to sample collection, a trip blank of deionized water used throughout the sampling program was prepared in the same manner used for all samples collected. The trip blank was preserved with the same chemical preservatives used on all samples and was analyzed for the same analytes. In addition to the trip blank, two duplicate samples were collected, prepared, preserved, and analyzed for the same analytes. These duplicates were coded in the field upon collection and given a different sample identification number to correspond to the first sample collected at the site.

Recordkeeping and Chain of Custody

During purging and sample collection at each monitoring well, field logs were used to record all field measurements and other pertinent information. This included water levels, volumes of water removed prior to sampling, pH, conductivity, and other physical measures.

Prior to the delivery of the samples to the laboratory, a chain of custody form was prepared identical to the labels secured on each sample bottle noting sample location and identification, date of sample collection, number of samples, and names of personnel collecting the samples. In addition, an analytical work request form was completed indicating laboratory analysis for all samples.

The original forms were sent along with the samples to the laboratory and a copy was retained by Donohue. The samples were placed in coolers with ice and delivered to the laboratory by Donohue personnel. All samples were delivered to the laboratory within 24 hours of sample collection.

Surface Water Sampling

Two samples of water from Lincoln Creek were collected on March 4, 1985. One sample was obtained at a point approximately 100 feet upstream of the landfill and the second from a point immediately downstream. The samples were handled by the same procedures used for the groundwater samples.

RESULTS

Field Measurements and Observations

During the installation of the groundwater monitoring wells, a photoionization detector was used to measure organic vapors in the soil, water, and air in the borehole. There was no positive meter reading for any of the samples. During the sampling of the monitoring wells, we noted that samples from all of the wells were odorless and colorless following filtration. There is no obvious indication of contamination in any well. A summary of field measurements and observations is given in Table 3.

Groundwater Chemistry

Results of laboratory analysis of the groundwater samples collected in January and February 1985, are given in Tables 4 and 5. Organic matter content of the water is very low, as indicated by the chemical oxygen demand (COD) values. No biochemical oxygen demand (BOD) readings were measured for the samples;

TABLE 3

FIELD MEASUREMENTS

Well No.	Depth to Water Level from Top of PVC Pipe (feet)	Temp. (oC)	Color	Odor (Y/N)	Turbidity
Blank					
1/3-4/85	N/A	9	None	N	N/A
2/13-14/85	N/A	11	None	N	N/A
P101A					
1/3-4/85	12.15	8	None	N	Slight Turbidity
2/13-14/85	12.70	7	None	N	Clear
OW101B					
1/3-4/85	12.95	8	None	N	Very Turbid
2/13-14/85	13.60	6.5	None	N	Very Turbid
P102A					
1/3-4/85	32.20	7.5	None	N	Slight Turbidity
2/13-14/85	13.80	6	None	N	Clear
OW102B					
1/3-4/85	11.18	7.5	None	N	Very Turbid
2/13-14/85	11.82	6	None	N	Very Turbid
P103A					
1/3-4/85	22.38	9	None	N	Moderate Turbidity
2/13-14/85	11.33	8	None	N	Clear
OW103B					
1/3-4/85	11.28	7.5	None	N	Very Turbid
2/13-14/85	12.23	7.5	None	N	Very Turbid
P104A					
1/3-4/85	17.07	6	None	N	Slight Turbidity
2/13-14/85	17.83	6	None	N	Clear
OW104B					
1/3-4/85	14.68	6	None	N	Very Turbid
2/13-14/85	13.70	6	None	N	Turbid
P105A					
1/3-4/85	6.48	5.5	None	N	Clear
2/13-14/85	7.50	6.5	None	N	Clear
OW105B					
1/3-4/85	8.18	6	None	N	Slight Turbidity
2/13-14/85	9.40	6.5	None	N	Turbid
P106A					
1/3-4/85	33.20	7	None	N	Extremely Turbid
2/13-14/85	29.10	6.5	None	N	Clear

TABLE 3
(Continued)

Well No.	Depth to Water Level from Top of PVC Pipe (feet)	Temp. (oC)	Color	Odor (Y/N)	Turbidity
OW106B					
1/3-4/85	7.00	5	None	N	Extremely Turbid
2/13-14/85	8.95	6.5	None	N	Turbid
P111A					
1/3-4/85	11.28	6	None	N	Clear
2/13-14/85	13.35	6.5	None	N	Clear
OW111B					
1/3-4/85	7.29	5	None	N	Slight Turbidity
2/13-14/85	10.10	6	None	N	Turbid
P109A					
1/3-4/85	13.08	8	None	N	Clear
2/13-14/85	15.60	6	None	N	Clear
OW109B					
1/3-4/85	12.47	7.5	None	N	Slight Turbidity
2/13-14/85	15.45	5.5	None	N	Turbid
P108A					
1/3-4/85	12.62	7	None	N	Clear
2/13-14/85	16.24	7.5	None	N	Clear
OW108B					
1/3-4/85	7.44	6	None	N	Clear
2/13-14/85	8.55	7	None	N	Slight Turbidity

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TABLE 4
LABORATORY ANALYSIS
(January 1985 Sampling Program)

Lab Number:	.01	.02	.03	.04	.06	.05	.07	.08	.09	.10	.11	.12
Sample Id.:	Trip Blank	P101A	OW101B	P102A*	P102A*	OW102B	P103A	OW103B	P104A	OW104B	P105A	OW105B
Sample Date:	1/3/85	1/3/85	1/3/88	1/3/85	1/3/85	1/3/85	1/3/85	1/3/85	1/3/85	1/3/85	1/4/85	1/4/85
Chemical Oxygen Demand, mg/l	<6.0	14.3	12.9	<6.0	<6.0	12.6	<6.0	10.1	<6.0	10.8	12.0	<6.0
Total Hardness (CaCO3), mg/l	15	792	118	493	493	749	269	705	712	606	700	611
Dissolved Solids, mg/l	39	1093	1600	683	675	984	294	816	894	637	931	647
Conductivity, umhos/cm	15	1200	1740	672	665	992	255	815	825	662	925	692
Chloride, mg/l	4.4	100	47.3	36.0	31.4	44.4	2.0	46.5	49.2	4.7	106	18.2
Fluoride, mg/l	0.1	0.4	0.2	0.7	0.9	0.3	0.9	0.6	0.7	1.0	0.6	0.7
Nitrate Nitrogen, mg/l	<0.1	<0.1	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate, mg/l	2.2	298	401	214	222	242	44.5	166	223	118	211	84.4
Sulfide, mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Arsenic, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01
Barium, mg/l	<0.5	0.6	0.5	<0.5	<0.5	0.5	<0.5	0.6	0.5	0.5	0.5	<0.5
Cadmium, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Iron, mg/l	<0.01	1.2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.2	<0.1
Lead, mg/l	<0.03	<0.03	0.03	0.06	<0.03	0.03	<0.03	<0.03	0.03	<0.03	0.04	0.03
Manganese, mg/l	<0.05	0.10	0.23	0.25	0.05	0.14	<0.05	0.05	<0.05	<0.05	0.10	<0.05
Mercury, mg/l	0.0005	0.0014	0.0013	0.0016	<0.0005	0.0018	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium, mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.10	0.20	<0.05	0.14	<0.05
pH (units)	7.15	7.30	7.10	7.75	7.80	7.30	7.90	7.25	7.55	7.75	7.35	7.35

All samples filtered in the field.
pH and conductivity measured immediately after collection and filtration.

*Duplicate samples

R/C0E2/AA9

TABLE 4
(Continued)

Lab Number:	.13	.14	.19	.20	.17	.18	.21	.15	.16
Sample Identification:	P106A	OW106B	P111A	OW111B	P109A	OW109B*	OW109B*	P108A	OW108B
Sample Date:	1/4/85	1/4/85	1/4/85	1/4/85	1/4/85	1/4/85	1/4/85	1/4/85	1/4/85
Chemical Oxygen Demand, mg/l	<6.0	<6.0	8.9	6.0	<6.0	9.8	8.4	6.0	12.0
Total Hardness (CaCO3), mg/l	337	615	1252	497	708	691	899	1252	1358
Dissolved Solids, mg/l	516	704	452	883	756	756	792	1449	1586
Conductivity, umhos/cm	478	722	570	880	795	810	812	1320	1420
Chloride, mg/l	18.5	20.2	7.1	1.3	32.3	3.4	<1.0	38.4	30.0
Fluoride, mg/l	1.0	0.6	0.6	0.2	0.9	2.4	0.2	0.1	1.2
Nitrate Nitrogen, mg/l	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.8
Sulfate, mg/l	104	178	91.9	238	318	298	250	479	516
Sulfide mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Arsenic, mg/l	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Barium, mg/l	<0.5	0.7	<0.5	0.7	<0.5	<0.5	<0.5	0.6	1.3
Cadmium, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Iron, mg/l	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1
Lead, mg/l	<0.02	0.03	<0.03	<0.03	0.13	0.05	0.04	0.07	0.06
Manganese, mg/l	0.13	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	0.07
Mercury, mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium, mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.07	<0.05
pH (units)	8.25	7.55	8.25	7.05	7.45	7.30	7.30	7.60	7.65

All samples filtered in the field.
pH and conductivity measured immediately after collection and filtration.

*Duplicate Samples

R/COE2/AA9

TABLE 5

LABORATORY ANALYSIS
(February 1985 Sampling Program)

Lab Number:	19432	19433	19434	19435	19436	19437	19438	19439	19440	19441	19442	19443
Sample Id.:	Trip Blank	P101A	OW101B	P102A	OW102B	P103A*	P103A*	OW103B	P104A	OW104B	P105A*	P105A*
Sample Date:	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85
Chemical Oxygen Demand, mg/l	1.5	12.4	14.1	3.6	18.1	4.8	1.5	4.6	7.6	8.0	10.4	10.8
Total Hardness (CaCo3), mg/l	30.0	713	908	454	684	268	268	656	654	518	668	646
Dissolved Solids, mg/l	82	1100	1410	652	1010	290	345	865	868	632	890	992
Conductivity, umhos/cm	12	1015	1320	598	962	345	348	852	805	610	930	928
Chloride, mg/l	5.8	103	50.8	35.5	49.2	2.8	3.0	47.0	51.2	7.6	91.8	88.6
Fluoride, mg/l	<0.1	0.52	0.45	0.96	0.55	1.10	0.91	0.46	0.81	0.85	0.47	0.40
Nitrate Nitrogen, mg/l	<0.1	<0.1	0.63	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate, mg/l	4.0	296	363	213	260	43.0	43.7	183	260	147	187	186
Sulfide, mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic, mg/l	<0.001	0.002	<0.001	<0.001	0.002	0.002	0.002	0.001	0.003	<0.001	<0.001	<0.001
Barium, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron, mg/l	<0.05	2.47	0.06	<0.05	<0.05	<0.05	0.05	0.17	<0.05	<0.05	<0.05	<0.05
Lead, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10
Manganese, mg/l	<0.03	0.06	0.17	0.07	0.08	<0.03	<0.03	0.11	0.05	0.06	0.10	0.1
Mercury, mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc, mg/l	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.05
pH (units)	7.20	7.15	7.05	7.55	7.10	7.75	7.75	7.20	7.55	7.70	7.30	7.30
Alkalinity (CaCO3), mg/l	26.7	462	835	240	560	247	256	491	379	386	466	462

All samples filtered in the field.
pH and conductivity measured immediately after the collection and filtration.

*Duplicate samples

R/C0E2/AA9

TABLE 5
(Continued)

Lab Number:	19444	19445	19446	19447	19448	19449	19450	19451	19452
Sample Identification:	OW105B	P106A	OW106B	P111A	OW111B	P109A	OW109B	P108A	OW108B
Sample Date:	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85	2/14/85
Chemical Oxygen Demand, mg/l	2.3	8.0	3.2	7.2	6.8	2.6	5.2	8.4	6.4
Total Hardness (CaCo3), mg/l	599	307	572	211	967	644	564	1260	1220
Dissolved Solids, mg/l	769	515	762	338	1180	850	710	1760	1580
Conductivity, umhos/cm	738	490	742	362	1100	750	685	1410	1320
Chloride, mg/l	31.9	21.3	24.5	10.2	3.5	35.2	4.0	26.5	29.7
Fluoride, mg/l	0.41	0.79	0.81	0.63	0.48	0.46	0.61	0.61	0.46
Nitrate Nitrogen, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.15	1.33
Sulfate, mg/l	141	104	185	92.9	347	292	193	650	494
Sulfide, mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic, mg/l	<0.001	0.002	<0.001	<0.002	<0.001	0.004	<0.001	<0.001	<0.001
Barium, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper, mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron, mg/l	0.18	<0.05	<0.05	<0.05	0.23	<0.05	<0.05	<0.05	0.07
Lead, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese, mg/l	0.06	0.08	0.09	<0.03	0.10	0.05	0.08	0.07	0.07
Mercury, mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Selenium, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc, mg/l	0.01	<0.01	<0.01	<0.01	0.02	0.01	0.03	0.03	0.02
pH (units)	7.25	7.85	7.30	9.15	6.85	7.40	7.15	7.00	7.05
Alkalinity (CaCO3), mg/l	469	252	409	174	690	334	413	706	771

All samples filtered in the field.
pH and conductivity measured immediately after collection and filtration.

R/COE2/AA9

however, because the chemical oxygen demand readings were low, it is reasonable to expect that the BOD values would be extremely low as well. The heavy metal concentrations in each well was low and in most cases, below the detection limits. The iron content in piezometer 101A was higher than the other wells and piezometers during both sampling programs. The concentration of hardness, total dissolved solids, chloride, and sulfate are higher than would be expected for background water quality. This is especially noticeable in P101 and OW101. The concentration of these components might be a result of the landfill; however, it is not possible to conclude that the landfill is the only impact on the area groundwater. Other urban activities in the area might contribute.

Surface Water Chemistry

Surface water data is presented in Table 6. There is no significant difference in parameters upstream and downstream of the landfill. Both samples were high in chloride, perhaps due to runoff of salt from roads.

CONCLUSIONS

The impact of the existing landfill on groundwater and surface water quality is small. The higher than expected concentrations of hardness, total dissolved solids, chloride, and sulfate in some wells which may be due to the landfill, do not warrant remedial action to cleanup the groundwater. Future environmental impacts from the landfill can be minimized by designing and constructing uses for the area that will not result in damage to the landfill cover and expose refuse. Damage to the cover will increase the rate of infiltration and perhaps increase the concentration of dissolved solids in the groundwater.

RECOMMENDATIONS

Based on the results of our evaluations, we recommend the following:

1. Abandon the monitoring wells used in this evaluation in accordance with Wisconsin Department of Natural Resources procedures. Abandonment of the wells will eliminate the possibility of contamination by vandals.

2. Design and construct training exercises on the landfill areas that will not damage the landfill cover. Implementing this recommendation might require reinforcing the paths, where tanks and heavy equipment are used.

R/COE2/AA1

TABLE 6

LINCOLN CREEK ANALYSIS

	Upstream of Landfill	Downstream of Landfill
Total COD mg/l	7.9	15.6
Total Dissolved Solids mg/l	756	844
Nitrate Nitrogen mg/l	2.06	2.37
Arsenic mg/l	<0.001	<0.001
Barium mg/l	<0.2	<0.2
Cadmium mg/l	<0.01	<0.01
Total Chromium mg/l	<0.05	<0.05
Copper mg/l	<0.05	<0.05
Total Iron mg/l	0.05	0.06
Lead mg/l	<0.1	<0.1
Manganese mg/l	<0.03	<0.03
Mercury mg/l	<0.0005	<0.0005
Selenium mg/l	<0.001	<0.001
Silver mg/l	<0.01	<0.01
Zinc mg/l	0.04	0.04
Alkalinity mg/l	226	235
Total Hardness mg/l	360	360
Chloride mg/l	235	235
Flouride mg/l	0.24	0.25
Sulfate mg/l	53.9	56.7
Sulfide mg/l	<0.1	<0.1
Conductivity, umhos/cm	875	858
pH, units	8.10	8.05

pH and conductivity were measured in the field immediately upon sample collection.

R/COE2/AB0

REFERENCE

Department of the Army (1984) Finding of No Significant Impact and Environmental Assessment, Expansion and Utilization of the United States Army Reserve Center Complex and Training Area, Milwaukee, Wisconsin.

APPENDIX A

BORING LOGS AND WELL INSTALLATION INFORMATION

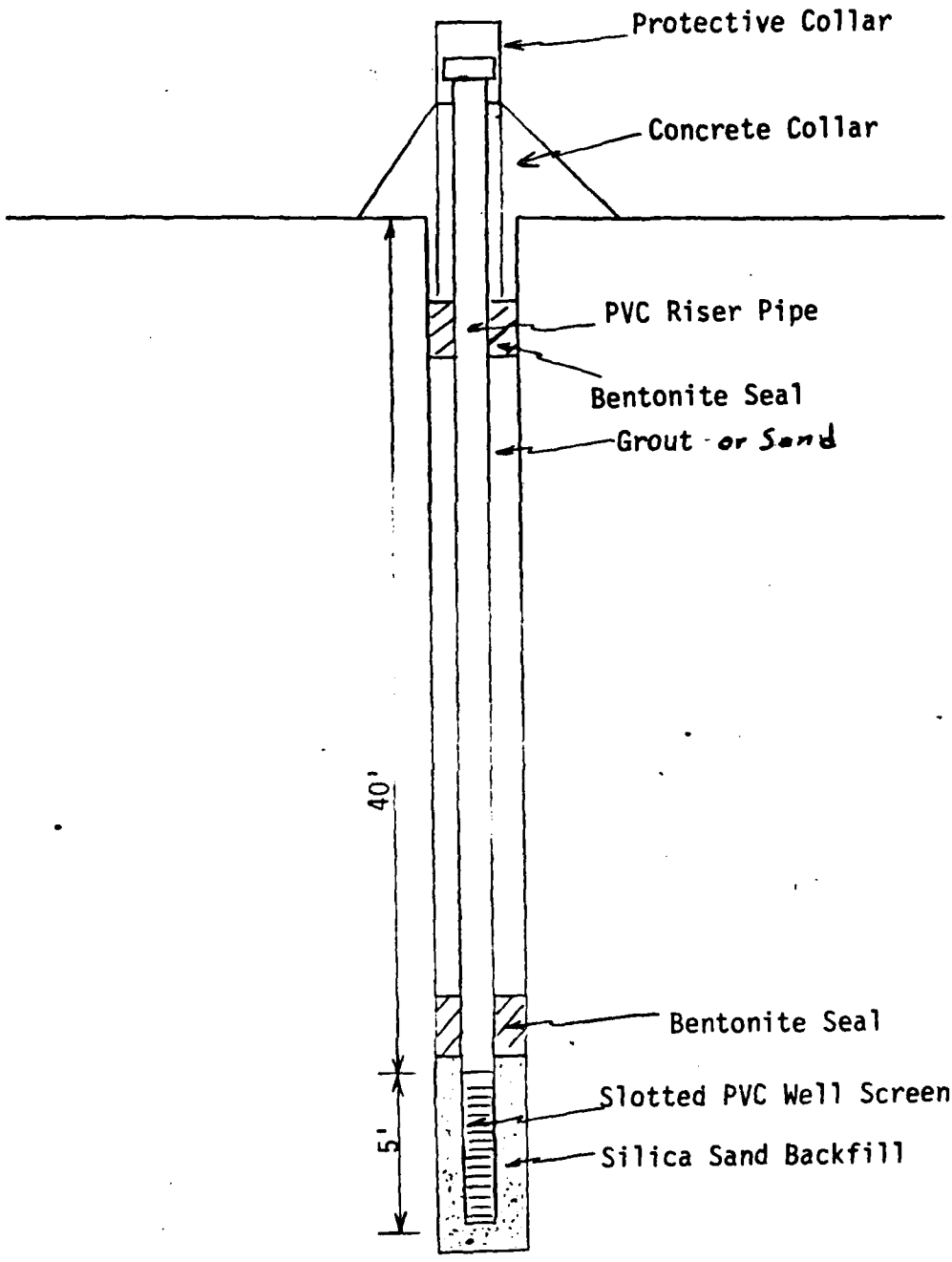

FIGURE 2
Typical Well Diagram (Deep Well)
U.S. Army Reserve Center
Milwaukee, Wisconsin
GEA Project No. 841022

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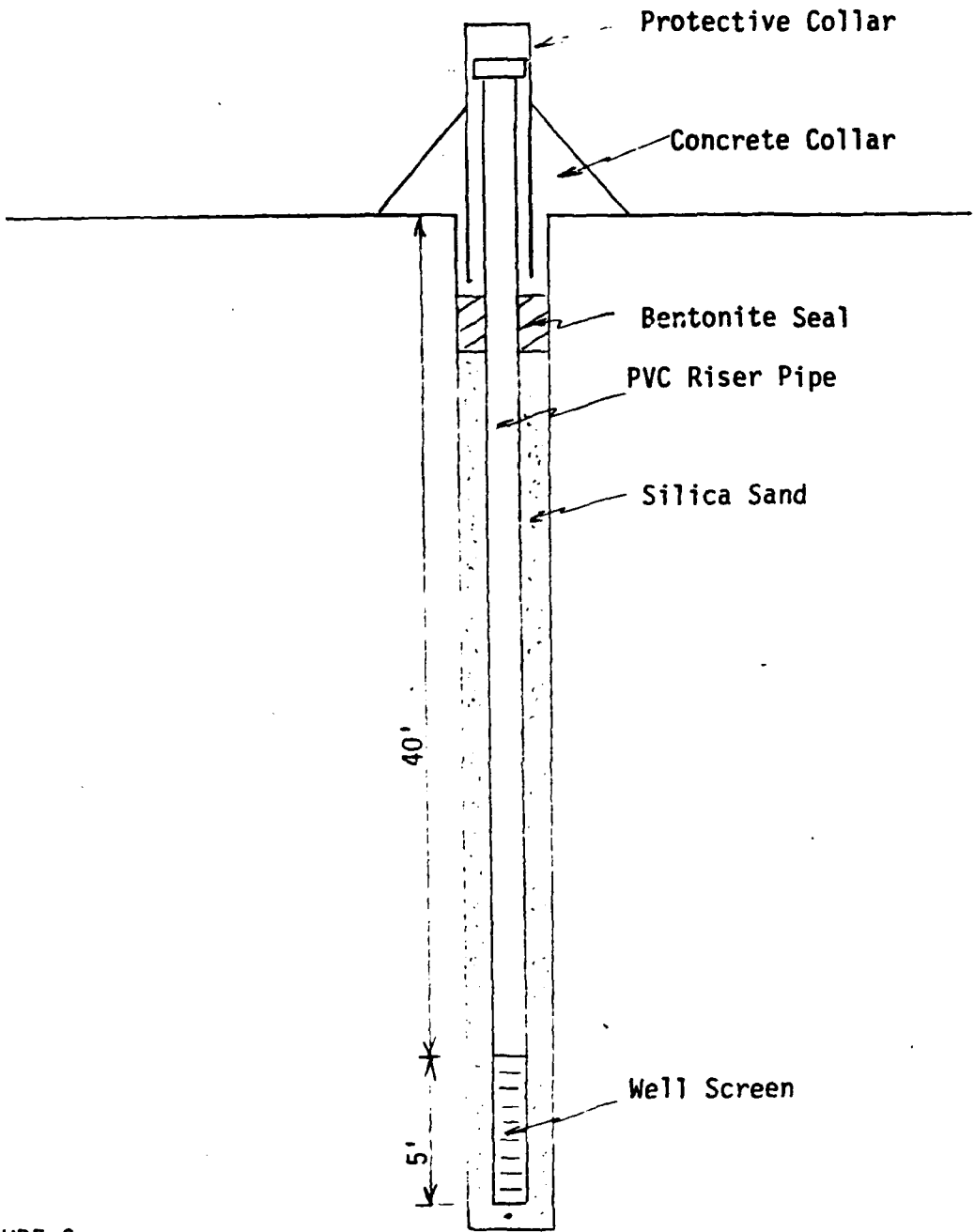

FIGURE 3
Typical Well Diagram (Deep Well)
U.S. Army Reserve Center
Milwaukee, Wisconsin
GEA Project No. 841022

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GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-101

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U. S. Army Training Center **Date:** 10-24-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Yellow Brown Silty fine to medium Sand, some coarse Sand, trace Clay-Damp (SP-SM)	5'	1-SS	31					
Gray Brown Clayey Silt to Silt, trace fine to coarse Sand-Damp (CL-ML)	10'	2-SS	9					
	15'	3-SS	8					
Gray fine to coarse Sand and Gravel-Wet (GW)	20'	4-SS	16					
	25'	5-SS	14					
	30'	6-SS	14					
Gray Silty Clay to Clayey Silt-Damp to Moist (ML-CL)	35'	7-SS	11					
Gray very fine Sandy Silt, trace Clay - moist to wet High Dilatency (SM)	40'	8-SS	36					
Gray very fine Sandy Silt, trace coarse Sand to fine Gravel-Moist to Wet (SL-SM)	45'	9-SS	32					
Boring Terminated at 46'								

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-101

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center

Date: 10-24-84

Milwaukee, Wisconsin

GEA Project No.: 841022

Crew Chief : Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Piezometer Set at 46'								
5' Well Screen	5'							
	10'							
	15'							
	20'							
	25'							
	30'							
	35'							
	40'							
	45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. OW-101

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Reserve Center

Date: 11-16-84

Milwaukee, Wisconsin

GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Auger Boring to 20'								
Set Well at 20'	5'							
	10'							
	15'							
	20'							
Boring Terminated at 20'	25'							
	30'							
	35'							
	40'							
	45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

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GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-102

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center

Date: 10-30-84

Milwaukee, Wisconsin

GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Yellow Brown fine Sand, trace medium to coarse Sand, trace fine Gravel-Damp (SP)	5'	1-SS	39					
Gray fine to coarse Sand and Gravel - Wet (GW)	10'	2-SS	25					
	15'	3-SS	57					
	20'	4-SS	38					
	25'	5-SS	15					
	30'	6-SS	13					
Gray Clayey Silt, trace fine to coarse Sand, trace fine Gravel-Damp (CL-ML)	35'	7-SS	46					
	40'	8-SS	36					
Gray very fine Sandy Silt, trace Clay, trace medium to coarse Sand, trace fine Gravel-Damp (SM)	45'	9-SS	33					
Boring Terminated at 46'								

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-102

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U. S. Army Training Center **Date:** 10-30-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Piezometer Set at 45' 5' Well Screen	5' 10' 15' 20' 25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. OW-102

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center **Date:** 11-16-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Auger Boring to 20' Set Well at 20'	5' 10' 15' 20'							
Boring Terminated at 20'	25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

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GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-103

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S, Army Training Center — **Date:** 11-8-84

Milwaukee, Wisconsin — **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Yellow Brown fine Sandy Silt, trace Clay, some medium to coarse Sand-Damp (SM-ML)	5'	1-SS	18					
Gray fine to coarse Sand and Gravel-Damp to Wet (GW)	10'	2-SS	23					
	15'	3-SS	37					
Gray Silty Clay to Clayey Silt, trace fine to medium Sand-Damp (ML-CL)	20'	4-SS	34					
	25'	5-SS	23					
Gray fine Sand, trace to little Silt-Wet (SM-SW)	30'	6-SS	71					
Gray Brown Clayey Silt to Silt, trace to little fine to coarse Sand, trace fine Gravel-Damp (CL-ML)	35'	7-SS	67					
Gray Brown Silty Clay to Clayey Silt-Damp (ML-CL)	40'	8-SS	66					
Gray Brown very fine Sandy Silt, trace medium to coarse Sand, trace fine Gravel-Damp to Moist (SM)	45'	9-SS	158					
Boring Terminated at 46'								

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-103

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U. S. Army Training Center **Date:** 11-8-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Piezometer set at 45' 5' Well Screen	5' 10' 15' 20' 25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. OW-103

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center **Date:** 10-24-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Auger Boring to 20' Set Well at 20'	5' 10' 15' 20'							
Boring Terminated at 20'	25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-104

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center

Date: 11-2-84

Milwaukee, Wisconsin

GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	w	REMARKS
Yellow Brown fine Sandy Silt, trace Clay, trace medium to coarse Sand-Damp to Moist (SM)	5'	1-SS	16					
	10'	2-SS	46					
Gray Brown Clayey Silt, some fine Sand, trace medium to coarse Sand, trace fine Gravel-Damp (CL-ML)	15'	3-SS	49					
Gray Clayey Silt to Silt, trace fine to medium Sand-Damp to Moist (CL-ML)	20'	4-SS	19					
Gray fine to coarse Sand and Gravel-Wet (GW)	25'	5-SS	26					
Gray Brown Silty Clay to Clayey Silt, trace fine to coarse Sand-Damp (ML-CL)	30'	6-SS	37					
	35'	7-SS	142					
		RB						
Boring Terminated at 38'-4"	40'							
	45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-104

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center

Date: 11-2-84

Milwaukee, Wisconsin

GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Piezometer Set at 38'-4" 5' Well Screen	5' 10' 15' 20' 25' 30' 35'							
	40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

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GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. OW-104

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center Date: 10-24-84

Milwaukee, Wisconsin GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	w	REMARKS
Auger Boring to 20' Set Well at 20'	5' 10' 15' 20'							
Boring Terminated at 20'	25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

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GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-105

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center Date: 11-15-84

Milwaukee, Wisconsin GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Yellow Brown Clayey Silt to Silt - Damp (CL-ML)	5'	1-SS	12					
Gray Brown Clayey Silt-Damp (CL-ML)	10'	2-SS	13					
Gray Brown Clayey Silt to Silt, trace medium to coarse Sand-Damp to Moist (CL-ML)	15'	3-SS	13					
	20'	4-SS	14					
Gray Brown Silty Clay, trace fine to coarse Sand-Damp (ML-CL)	25'	5-SS	39					
	30'	6-SS	32					
	35'	7-SS	26					
	40'	8-SS	19					
Gray fine to coarse Sand and Gravel-Moist (GW)	45'	9-SS	25					
Boring Terminated at 46'								

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-105

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center Date: 10-29-84

Milwaukee, Wisconsin GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	w	REMARKS
Piezometer set at 45' 5' Well Screen	5' 10' 15' 20' 25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. OW-105

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center Date: 11-15-84

Milwaukee, Wisconsin GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Auger Boring to 20' Set Well at 20'	5' 10' 15' 20'							
Boring Terminated at 20'	25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

CONSULTING SOIL AND FOUNDATION ENGINEERS

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-106

Project: U.S. Army Training Center
Milwaukee, Wisconsin

Date: 10-31-84

GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Yellow Mottled Gray Brown Clayey Silt to Silt-Damp (CL-ML)	5'	1-SS	18					
Gray Brown Clayey Silt to Silt, some very fine Sand Seams-Damp to Moist (CL-ML)	10'	2-SS	15					
Gray Brown Silty very fine Sand, trace medium to coarse Sand, trace fine Gravel-Damp to Moist (SM)	15'	3-SS	17					
Gray Brown very fine Sandy Silt-Damp (SM)	20'	4-SS	46					
Gray Brown Clayey Silt to Silt-Damp (CL-ML)	25'	5-SS	57					
Gray Brown Silty Clay to Clayey Silt, trace to little fine to coarse Sand, fine Gravel-Damp (ML-CL)	30'	6-SS	66					
	35'	7-SS	53					
	40'	8-SS	34					
	45'	9-SS	38					
Boring Terminated at 46'								

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

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GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-106

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center Date: 10-31-84

Milwaukee, Wisconsin GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Piezometer set at 45'	5'							
5' Well Screen	10'							
	15'							
	20'							
	25'							
	30'							
	35'							
	40'							
	45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. OW-106

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center — **Date:** 11-15-84

Milwaukee, Wisconsin — **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Auger Boring at 20' Set Well at 20'	5' 10' 15' 20'							
Boring Terminated at 20'	25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-107

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center — **Date:** 11-13-84

Milwaukee, Wisconsin — **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Auger Boring with SPT to 15' No samples retained per inspector	5' 10' 15'							
Boring Terminated at 15'	20' 25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

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GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-108

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center — **Date:** 11-6-84

Milwaukee, Wisconsin — **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Yellow Brown Silty Clay to Clayey Silt, trace fine to medium Sand (Possible Fill)-Damp (ML-CL)	5'	1-SS	6					
Yellow Brown Silt, Trace Clay-Damp (ML)	10'	2-SS	29					
Yellow Brown very fine Sandy Silt, trace Clay, trace to little medium to coarse Sand, trace fine Gravel-Damp (SM)	15'	3-SS	50					
Gray Brown very fine Sandy Silt, trace Clay, trace medium to coarse Sand-Damp to Moist (SM)	20'	4-SS	32					
	25'	5-SS	26					
Gray fine to coarse Sand and Gravel-Wet (GW)	30'	6-SS	52					
(Probable Bedrock) at 32' Limestone	35'	RB						
	40'							
Boring Terminated at 42'	45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-108

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center **Date:** 11-6-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	w	REMARKS
Piezometer set at 42' 5' Well Screen	5' 10' 15' 20' 25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. OW-108

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center

Date: 11-7-84

Milwaukee, Wisconsin

GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	w	REMARKS
Auger Boring to 20' Set Well at 20'	5' 10' 15' 20'							
Boring Terminated at 20'	25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-109

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center
Milwaukee, Wisconsin

Date: 10-19-84, 10-23-84

GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Gray Mottled Yellow Brown Silt, trace fine to coarse Sand, trace fine Gravel-Damp (ML)	5'	1-SS	30					
	10'	2-SS	26					
Yellow Brown Silt, fine to coarse Sand and Gravel-Wet (ML)	15'	3-SS	69					
Gray Brown Silty Clay, some fine to coarse Sand, fine Gravel-Damp (ML-CL)	20'	4-SS	83					
Gray Brown very fine Sandy Silt, trace to little medium to coarse (SM) Sand, trace fine Gravel-Damp to Moist	25'	5-SS	110/4.5"					
Probable Bedrock (Limestone)		RB						
Boring Terminated at 27'	30'							
	35'							
	40'							
	45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P -109

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center **Date:** 11-13-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	w	REMARKS
Auger Boring to 24' Set Casing Rock Roller Bit to 36' Set Well at 36'	5' 10' 15' 20' 25' 30' 35'							
Boring Terminated at 36'	40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. OW-109

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center **Date:** 10-19-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	%	REMARKS
Boring 109 Re-augered to 27' Boring backfilled to 20' with Bentonite Pellets Well set at 20'	5' 10' 15' 20'							
	25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-111

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center **Date:** 10-16-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Yellow Brown Silty Clay, trace to little fine to medium Sand, (Possible Fill)-Damp (ML-CL)	5'	1-SS	16					
Yellow Brown very fine Sandy Silt, trace fine Gravel-Damp to Moist (SM-ML)	10'	2-SS	18					
Gray Brown very fine Sandy Silt, trace medium to coarse Sand, trace fine Gravel-Damp (SM)	15'	3-SS	66					
Gray Brown Silty Clay, some fine Sand Seams-Damp (ML-CL)	20'	4-SS	41					
Gray Brown Clayey Silt to Silt-Damp (CL-ML)	25'	5-SS	11					
Gray Brown Silty Clay to Clayey Silt, some fine to coarse Sand, fine Gravel- Moist to Wet (ML-CL)	30'	6-SS	184					
	35'	7-SS	111/5"					
Boring Terminated at 38'-6"	40'							
	45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No. P-111

CONSULTING SOIL AND FOUNDATION ENGINEERS

Project: U.S. Army Training Center — Date: 10-16-84

Milwaukee, Wisconsin — GEA Project No.: 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Piezometer set at 38'-6"	5'							
5' Well Screen	10'							
	15'							
	20'							
	25'							
	30'							
	35'							
	40'							
	45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

CONSULTING SOIL AND FOUNDATION ENGINEERS

Boring No. OW-111

Project: U.S. Army Training Center **Date:** 10-19-84

Milwaukee, Wisconsin **GEA Project No.:** 841022

Crew Chief: Duane Drewicz

DESCRIPTION Ground Surface Elevation	Depth Below Surface	Sample No. & Type	N	q_u	q_p	q_s	W	REMARKS
Auger Boring to 20' Set Well at 20'	5' 10' 15' 20'							
Boring Terminated at 20'	25' 30' 35' 40' 45'							

Changes of strata indicated by the lines are approximate boundary between soil types. The actual transition may be gradual and may vary considerably between boring locations.

GILES ENGINEERING ASSOCIATES, INC.

GENERAL NOTES

SAMPLE IDENTIFICATION

All sample classifications are reviewed by a soils engineer in accordance with the Unified Soil Classification System (ASTM D-2487)

SOIL PROPERTY SYMBOLS

Dd: Dry density, pcf
LL: Liquid limit
PL: Plastic limit
W : Moisture content
N : Penetration resistance per foot or fraction thereof of standard 2 inch O.D., 1 3/8 inch I.D., split spoon sampler driven with a 140 pound weight free-falling 30 inches, in accordance with Standard Penetration Test Specifications (ASTM D-1586)
q_p: Penetrometer value, tsf
q_s: Vane-shear strength, tsf
q_u: Unconfined compressive strength, tsf
▼ Apparent ground water level at the time noted after completion

SOIL STRENGTH CHARACTERISTICS

COHESIVE SOILS

Comparative Consistency	Blows Per Foot	Unconfined Compressive Strength (tsf)
Very Soft	0 - 2	0 - 0.25
Soft	2 - 4	0.25 - 0.50
Medium	4 - 8	0.50 - 1.00
Stiff	8 - 15	1.00 - 2.00
Very Stiff	15 - 30	2.00 - 4.00
Hard	30+	4.00+

NON-COHESIVE (GRANULAR) SOILS

Relative Density	Blows Per Foot
Very Loose	0 - 4
Loose	4 - 10
Firm	10 - 30
Dense	30 - 50
Very Dense	50+

DRILLING AND SAMPLING SYMBOLS

SS: Split-Spoon
ST: Shelby Tube - 3" O.D. (except where noted otherwise)
AU: Auger Sample
DB: Diamond Bit
CB: Carbide Bit
WS: Washed Sample
RB: Rock-Roller Bit

APPENDIX B

WELL DEVELOPMENT LOGS

lock ok   1 Vol = 12.7 x5 = 63.5

Donohue
Engineers & Architects

Well Development

Project No. ______ Site P101

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment ______ Airlift ______ N2 Lift ______ In. Bailer ______ Length ______ Ft. Material ______

Pump ______ Manufacturer [illegible] ______ Diameter ______

Description of site (weather, temp, soil conditions) ______

[illegible] Entered on computer ______ Signature ______ Date Start 11/15/84

Well No / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
P-101 9:55	47.6	13.13	6.5	48.96	7.50	250*	clear	N	9°C	moderate.	Pump sucked out a small amount of slurry	
2:30		13.15	6.5 ①							"		
11/16 11:45	48.90	13.18	5	–	7.06	1250	N	N	9°C	Moderate		12
					7.05	1090	N	N	10.5	Clearer		
11/19 11:30	48.92	13.15	7 ②	47.27						Turbid		11:
11/19 2:45	48.92	13.20	6.5									
11/20 10:42	48.93	13.23	7 ③	48.93	7.02	912	N	N	11°C	Started to clear	Took Sample	10.
11/20 1:40	48.93	13.23	8.5	48.93						" "	starting to recharge	2
11/21 11:35	48.92	13.23									Set up ISCO @ 11:35	
			5 + [illegible]							start	12:15 bucket was	
											over [illegible]	
			3								12:40	
			5								1:20	
			5 + 5								2:[illegible]	
			5		7.07	875	N	N	9	moderate	Pumped dry [illegible]	
											[illegible] - took	
											sample	2:
											5 volumes out	
											but still not	
											clear!	
11/21 [illegible]		13.55	7							moderate		
11/27 10[illegible]	48.72	[illegible].08	5	48[illegible]						moderate		1
										[illegible] clear		
11/30 11:13	48.93	[illegible].04	6							moderate		11:

* [illegible]

Starts out muddy then [illegible]

Needs H.D. Lock 1 Vol. 4.8 ≈ 5 × 5 = 25 gal Tot

Donohue Engineers & Architects

Well Development

Project No. _____ Site OW 101 * No Casing Well

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 11/16/84

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
11/16 11:47	20.19	7.13	3	20.39		1050	Amber	S	9°C	Extreme		12:10
11/19 11:30	20.34	13.92	4.5	21.53	6.84	1150	clear	N	10°C	Ext. Turb	Took Sample	11:50
11/9 2:45	21.42	13.92	4.5							Starting to clear		
			4.5						-			
			4.5		6.69	970	N	N	9.5°C	Get. clearer	Took Sample	
			4.5									
			4.5									
			4.5							clear		
			4.5		6.71	980	N	N	9.5°C		Took Sample	
		13.98	—	21.43								
11/20	21.46	13.98										

1 Vol = 12.8 x 5 = 64

Donohue

Engineers & Architects

Well Development

Project No. _____ Site P102

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer Geek Pump _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Sunny & Hot

Started

Entered on computer _____ Signature _____ Date 11/15/94

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
11/16 10:30	46.98	12.1-	6	too muddy	6.65	265	Yellow Green	N	8.5°C	moderate	sucked out small amount of slurry	Fini
2:15		27.33	3.5	47.42						"		
11/16 12:20	47.43	12 ~	3.5 (1)								H2O: 33 45 using gas pump	
11/19 11:00	47.43	12.30	5									11:30
11/19 2:35		27.85	2.5	47.44								2:40
11/20 11:00	47.43	12.44	5 (2)	47.43	7.47	560	N	N	13.5		Took Sample	11:20
11/20 2:06		25.00	9							Clearing	Started to recharge Quicker	
11/21 11:15		12.39									Setup ISCO @ 11:30	
			1.5								12:20 - pump	
											moving mo-7	
11/21 12:5			6.0								using gas pump	
11/21 2:15		27.90	3.0							"		
			3									
11/27 1:30	47.43	12.12	5							muddy at first then clearing & moderate	Gas Pump	1:42
11/29 11:35	47.43	12.12	5.5							Clearing		11:42
11/29 2:02		26.48	35							"		2:12
11/30 1:30	47.43	12.12	6		7.74	560	N	N	13°C	Clearing	Took Sample	
11/30 2:12		22.33	4							Clearing		2:17

Donohue Engineers & Architects

Well Development

Project No. _____ Site P101 page 2

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 1/1

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
11/29 1:49		13.03	6							Moderate		1:5
11/30 10:36	48.92	13.03	7	48.92						Moderate ~ 9		10:4
11/30 1:57		13.03	7							Clearing	2nd time Moderate	

1 Vol = 3.2 gal x 5 = 16 gal Total

Donohue

Engineers & Architects

Well Development

Project No. _____ Site OW102

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date Stewart 11/16/84

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
11/16 12:20	21.14	12.49	16		7.15	1000	N	N	9 °C	Turbid but (5)	Recharges Quickly	1:08
			15	21.52	6.98	1010	N	N	10.5	clearing to		
										very clear		
11/18	21.46	12.30		21.46								
11/20 11:00	21.46	12.32										

Donohue

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Well Development

Project No. _____ Site P103

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date Start 11/14/84

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
P103 7:00	43.58	13.32	5	Muck	8.10	280*	N	N	9.5°C	Extreem		
11/15 8:30	45.5	14.45	5	46.85	No	Sam	ple			Extreem		
11/16 9:00	46.2	19.84	5		"	"			8.5°C	Turbid but clearing	(1)	9:
11/16 7:50		27.74	2	46.83		No Sample						2.
11/19 8:45		11.25	5	46.62		No Sample				Getting Clearer	91.2 Gal. Pump (2)	9:
11/19 1:00		27.23	2.5							Turbid again		1:
11/20 8:05	46.10	12.98	5	46.41	7.69	348	N	N	9.5°C	Turb-Clearing	Took sample	8:
			(2	27½ to 9								
11/23 12:30		27.51	3							Turbid again		
11/21 9:10	46.85	12.25	5	46.85		No	Sample			Turb.		9
1:40		25.00	Wait									
11/21 3:25		24.70	3.5			No	Sa	ple		Turb.	Got Sample	
11/27 10:57	46.85	11.17	5.5	46.8		N	Sample			Turbid	Clear	11:
11/27 5:51		27.78	2.5									3:
11/28 8:48	46.85	11.24	5	46.85						Clearing		9:
11/28 12:27		26.55	3							"		12
11/30 8:56	46.85	11.78	5	46.85	13	385*	N	N	11°C	Clearing	Took Sample	9:
11/30 0:40		25.82	3							"		12

* Not [illegible] Turbidity [illegible] Filtered

(*) pH meter Not working right

Nind Ho. Lox 1 vol: 3.5 x 5 - 17.5 Gal Tx

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Well Development

Project No. _____ Site 2C'103

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date start 11/14/ 87

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments
11/14 3:00	21.50	12.10	2	22.45	7.65	530	N	N	12°C	Extrem.	> 4
11/15 8:30	22.45	12.10	2		No Sample					Extrem.	
11/16 8:35	22.47	12.21	5+2		7.35	830* 780F	N	N	23°C!	Heating to up	Start up to recharge
									18°C!		At the pump - Throttle
11/16 1:50		12.13	10		7.30	830F	N	N	11°C		
			10	22.43	7.28	880F	N	N	11°C	Extrem clear	
11/19		12.20									

Needs H. Block (Chippewa)

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Well Development

Project No. _____ Site P104

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 11/14/84

Well No / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp	Turbidity	Comments	
P104 12:40	37.4	18.05	3	38.25	8.45	430	N	N	11°C	Extreme T	H.W. level 20.8 ft	12-6
		22.6	4 = 7								7 = (1)	
			1	38.33								
11/5 12:30	38.36	17.88	9.5									
11/16 9:45	38.33	18.24	5			No Sample			9°C	Cleared	7 (2)	10:06
11/19 9:20		18.30	6	38.33		No Sample				Clearing then	+	
11/19 1:15		18.30	5		7.03	775	N	N	12°C	Muddy again	Took Sample	
11/20 8:30	38.31	18.45	5	38.34						Still hazy, Turbid		8:47
			5									
11/20 12:50		18.47	5							Still hazy Turbid	38.5' TOTAL	
											for (5) Volumes	
											keep going till clears	
11/21 9:55	38.32	18.47	5		7.07	870	N	N	9°C	Clear when drawing from top - Turbid near bottom	Took sample	10:10
11/27 11:44	38.31	17.92	5	38.31						Clearing but muddies up near Bottom		12.01
11/29 9:38	38.32	18.06	5	38.32						Clearing		9:22
11/29 12:45		18.00	5							Clearing to Moderate		1:00
11/30 9:30	38.32	17.98	5	38.32						Clears then		9:44
11/30 1:00		18.08	5							Gets muddy after 2 min	Moderate 2nd X	

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Well Development

Project No. _____ Site OU 104 ZNR

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Finish Start Date 11/14/84

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
104 12:50	22.65	10.48	2.5	23.1	7.50	630	N	N	12°C	Extrem.		
11/15 12:30	23.05	11.40	2.5								4.5 =	①
											.5	
11/16 9:45	23.23	12.39	4			sample			19°C	! clearing	- 4.5 =	② 10:
11/19 9:20		11.53	2	23.22		no sample				clearing		
11/19 1:15		15.90	1.5							Turbid		
11/20 9:30	23.21	14.32	1.5	23.22	7.16	578	N	N	9°C	clearing	Took sample	8:
11/20 12:50	23.23	16.92	NOT	enough	H_2O	to	get	pump	goin			1:1
11/21 9:55	23.22	13.82	2		No	Sample				Clearing		10.
11/27 11:41	23.23	11.57	2	23.23		No Sample				Clearing		11:
11/28 9:88	23.23	11.45	2.5	23.23		sample				Clearing		9:(
11/28 1:00		16.22	1.5									1:1
11/30 9:23	23.23	13.88	1	23.22	7.34	1604	N	N	12°C	Clearing	Took Sample	⊛ 9:
11/30 1:01		14.93	1							11		1:(

⊛ pH meter not working right.

Lock OK 1 vol = 14.2 x 5 = 71 gal

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Well Development

Project No. _____ Site P105

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date Samuel 11/15/24

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments
11/15 9:00	45.78	7.33	22.5		7.05	540*	light brown	N	9°C	Turbid	Good recharge rate
										cleared up	22.5 gal @ 9:10am
										Quick	
10:00		7.60	36		6.30	1010*	clear	N	9°C	clearer	took sample @ 36 gal
			13.5							" "	= 72 = 5 volumes
10:30			(72)								
			27		6.25	1070*	clear	N	9°C	extremely	took sample
			45	72						clear!!	= 72 = 5 volumes
10:50		7.97	(72)	45.88							
11/19	45.86	7.54									
11/20 10:18	45.86	7.63									

Nicol's H.B. Lake 1 Vol: 4.6 L or 5 gal x 5 = 25 Total

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Well Development

Project No. 684 Site OW 105

Method of Development Pumped [X] Bailed [ ] Blown [ ]

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

TMC Entered on computer _____ Signature _____ Date 11/16/84

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
11/16 11:20	21.71	9.04	4		7.12	795 F	N	N	12°C	Extremely Turb		11:35
11/19 10:06	22.50	9.03	40*		6.91	740 F	N	N	12°C	Turbid but clearing	Took Sample	10:30
11/19 2:15		9.01	5**								Recharging Fast	
			5**		6.84	750 F	N	N	11°C		Took Sample	
			10							starting to clear		
11/20 10:15	23.02	9.10	20	23.02		730	N	N	9.5°C	Again Start out Turbid		10:3
										Starting to clear to		
										Very Clear		
		H2O Level back to 9.10 after 3 minutes										
		∴ Very fast recharge !										

* Started to clear around 25 gall.

** Due to Turbid

Meade H.S. Lock 1 in = 11.9 gal x 5 = 59.7 60

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Well Development

Project No. _____ Site P106 Cement cracking @ base of well

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp. soil conditions) Wet + Muddy + COLD!

Entered on computer _____ Signature _____ Date 11/15/89

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
P-106 3:00	41.73	9.35	5.5	Muck	7.85	235	Brown	N	8°C	mod.- extreme	thick slurry on bottom.	
11/16 10:50	37.00	approx	Extreme	Mucky		not	much	H_2O				
* 11/19 9:45	46.45	18.03	4.5	46.45						Extrem. Turb		10:0
11/19 3:00		43.10 !!	Wait!									
11/20 9:10	46.45	35.62	1.5		7.58	968	N	N	9°C	"	Took Example Sample	10:11
11/20 1:30	46.45	44.03	Wait!									
11/21 11:00	46.45	36.60	1							extreme		N:1
1 :1 3:05		43.70	—									
11/27 12:45	46.45	12 lbs	5	4[illegible]						Turbid		1:
11/29 11:01	46.45	31.21	2							Turbid		11:1
11/30 12:[illegible]		38.34	1		7.3	1648	LIGHT TAN	N	11°C	"	Took Sample	1:2

* pH [illegible]

Needs H.D. Lock   1 Vol = 4 gal x 5 = 20 Total

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Well Development

Project No. ______________ Site OW 106

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment ______ Airlift ______ N2 Lift ______ In. Bailer ______ Length ______ Ft. Material ______

Pump ______ Manufacturer ______ Diameter ______

Description of site (weather, temp, soil conditions) ______

* Vandals lock pushed cap gone well pipe cracked [illegible]

Entered on computer ______ Signature ______ Date 11/16/84 final

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
11/16 10:45	19.13	7.86	4	20.10	Mucky		-		9.5°c	Mud	(1) sample Next time	11:10
* 11/19 9:45	20.61	7.45	4+									10:00
			5 (10:45)									
			5 (12:00)		7.36	740 F	clear	N	9°c	Turbid Starting	Took Sample	
		18.75	6 (2:00)	20.70						to clear		
									9°c	clear		
			(24)		7.26	750 F	N	N	9°c	Slightly Cloudy	Took Sample	
11/20 9:54	20.93	8.05										

11.2 gal = 1 ft x 5 = 56.2 gal. Total

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Well Development

Project No. _____ Site P108

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 11/13/

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments
P108 9:45	44.84	14.46	2gal								Hit bedrock after 2gal
											= 18.5 recovery feet
11/14 ~~9:45~~		~~15.18~~	~~2 gal~~	~~17.38~~							up to 16 after 4 min
11/14 9:35		15.18	2 gal	17.38	7.95	490*	None	None	9°C	clear	took sample
9.45		15.38	2 gal.								
10:15		15.18	12 gal	18.78						slightly cloudy	set up pump for continuous running
11:05		15.58	7 gal							clear	
3.00		15.15	21 gal		6.65	1300*			8.5°c	very clear	Took sample
4.15		15.66	10 gal		6.65	1280*			9°c	" "	" "
			(56)								
11/20 9:37	in 2	15.84									

* NOT Filtered

Donohue Engineers & Architects

Well Development

Project No. _____ Site OW 108

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 11/13/84

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments
OW108 3:30	22.88	8.05	3gal	21.5							3 gallons
11/14 9:30		7.85	3 gal.	22.88	6.85	1420	None	None	9°C	milky brown	Tock sample
10.30		8.30	3 gal	bottom						first - then clear	
11:20		8.45	3 gal.	"						" "	
1.55		8.30	3 gal.	"						"	
2:30		11.28	2.5gal	"						" "	
4.15		10.88	2.5	"	6.65	1360	None	N	9.5	clearing up	Tock sample
11/15 1.15		7.90	5 gal.							Clear	
1:40			2 gal		6.15	1360*	Just Clear	N	9°C	"	Tock Sample
			27								
11/20 9:42	23.45	8.35									

* [illegible] clear

Need I.D lock 110' = 9 Gall x 5 = 45 Gall

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Well Development

Project No. _____ Site P109

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter 2" PVC

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 11/15/84 Start

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
11/15 1:20	39.15	14.76	4	'Man'	7.80	430	clear	N	8.5°C	Extreme	Took Sample	1:35
11/16 10:20	39.14	14.95	4 ①									10:37
11/19 12:05	39.14	15.10	4	39.14						Extreme		
11/20 9:30	39.14	15.41	4.5							Turbid		9:45
11/20 1:20		16.14	3.5②							starting to clear		130
11/21 10.45		15.43									used Isco Pump	
11:45			2.5								Pump sucking mostly air	
12:55			1		7.47	700	N	N	9°C		Took Sample	
11 21 3:15			3							clear	Isco	
3 =			2.5							Turbid	Gas Pump	
11/27 12.18	39.14	14.83	4.5							Clearing	Gas Pump	12:1
11/28 10:43	39.14	14.98	4.5	39.14						Clearing		10:5
11/29 1:34		15.80	4							"		1:3
11/30 10:05	39.14	14.87	4.5	39.14	7.10	800*	N	N	10°C	Clearing	Took Sample	10:1
11/30 1:41		15.19	4.5							Clearing		1:4

F = filtered * pH meter not working

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Well Development

Project No. _____ Site OW 109

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 11/13/84

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments
OW109 11:05	22.42	14.40	0		7.05	1005	N.	N	11.5°C	Extremely Turbid	15 w/bailer
											3 w/pump - cleaning
11:48	22.49		18	22.49	6.95	660	N	N	13.0°C	Clearer st.ll slight sed.	after 18 gal develop
1:20	22.46	14.28 or .3	2 →	22.46	7.05	570	N	N	12°C	clearer " "	w/pump 2gal
3:18	22.46	14.20	2	22.45		look Sample ↓				Clearer by fan	w/pump 2gallons
4:30					6.85	530	N	N	6°C		
11:37	22.46	13.87		clogged [illegible]							looks Nice

Donohue

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Well Development

Project No. _____ Site D-111

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 11/13/84

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments
P111 9:20	39.73	12.79			7.95	500	None	N	11.5°	very turbid	Cond std: 1300 OK
											measured conductance on
	40.70										filtered sample
											0.45 mfilt
											dry after 7.0 gal
											slow recovery
P111 12:20	40.70	13.18									remove 3 more gallons (1)
12:47	37.5 →				7.25	560	None	No	9.5	very turbid	Still very turbid = 10
											→ took out 3 gal to dry
2:20	40.7 (sand)	12.91									
2:40	40.7 —					"	"			"	+ 7 gallons = 10 (2)
1/14/85 9:30	40.70	12.42	3 gal w/ bailer + 5 gal w/ pump		7.23	496 mS	None			Turbid	
					↑						
"	40.70	"	5 gal	40.7	7.05	560	"	N	9.5	Cleaning	+ 2 gal = 10 → (3)
											+ 2
1:45	40.70	12.2	9	40.7		N/A	Sample			Cleaning	- 6
											- 3
4:00	40.70	12.30	7	40.7	6.85	550	N	N	9	Clear	+7 = 10 (4)
11/19 12:20	40.70	12.80									
11/20		13.04									

look ok 6 Soil = [illegible] = 30 Total

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Well Development

Project No. _____ Site OW 111

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 11/13/24

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments
OW111 9:20	20.75	5.36			6.85	1180	None	N	12°C	Extreme Turbid	dry after 4.0 gal. moderate recovery conduct on clear sample.
OW111 1:08	21.4	7.8			6.90	1000	None	N	11.5	Very Turbid	+2 Soil = 6 (1)
1:16	←18.8→										+1 Gallon
2:20	22.23	8.13									
2:30	22.52	←				1/2 Sample				Extremely Turbid	+4 Gallons
11/14/24 9:30	22.52	7.62	3	22.52		None	None			Greater Slight Turb	+1 Gal w/pump = 6 (7) + Drawdown
10:50	22.52	7.85	3	22.52	6.85	1080	None	N	10°C	" "	+3
1:45	22.52	8.00	3	22.52						Slightly Turbid	+1 = 6 (3)
											+2
4:00	22.52	7.20	3	"						Clearing w/ Some Turb	+3
11/15 1:00	22.52	7.50	3	"						"	+1 = 6 (9)
											+2
11/19 10:05	22.51	7.60	3	"	6.76	1010	11	N	12°C	Very Turbid	+3 10:20
11/19 12:20	22.50	8.35	2.5	"						Still Very Turbid Water	
11/20 9:15	22.50	8.82	3	"						Turbid but Slightly Clearing	9:20
2:30		8.72	3 *	↓						can see H2O coming in	

* Very Turbid Water

go to Page 2 →

Donohue
Engineers & Architects

Well Development

Project No. _____ Site OW11 page 2

Method of Development Pumped ☐ Bailed ☐ Blown ☐

Equipment _____ Airlift _____ N2 Lift _____ In. Bailer _____ Length _____ Ft. Material _____

Pump _____ Manufacturer _____ Diameter _____

Description of site (weather, temp, soil conditions) _____

Entered on computer _____ Signature _____ Date 1 1

Well No. / Time	Depth to Bottom	Depth to Water	Volume Removed (gal.)	Depth After	pH	Cond.	Color	Odor Y/N	Temp.	Turbidity	Comments	
11/21 10:30		8.95	3							Very	Alot of Lime sand	10:37
11/21 1:55		9.10	3							"		12:05
11/21 1:50		10.60	3-							clearing a little		1:55
11/87 9:37		8.83	2.5							Turbid - Jel	Look Crinkin Layers like some one was	
								Took Sample			Trying to Break into the well	
11/89 1:21		8.30	3							Turbid Yet		10:34
11/89 1:21		8.24	2.5							" Clearing Some		1:26
11/89 9:51		8.15	2							Clearing but gets muddy		9:59
11/89 [illegible]		8.12	3							Near Bottom		1:32